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President - Business Development

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By Hand

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY January 12, 1994

Mr. William F. Caton
Acting Secretary
Federal Communications Commission
1919 M Street, NW
Washington, D.C. 20554

Re: Ex Parte Presentation
CC Docket No. 92-297,
Local Multipoint Distribution Service

Dear Mr. Caton:

On behalf of Bell Atlantic Enterprises, enclosed please find two copies of a letter prepared at our invitation by Bernie Bossard, the inventor and Chief Engineer of the Suite 12 LMDS technology. Mr. Bossard's letter addresses the applicability of some of the assumptions and technical boundary values used in the Comsat Laboratories study, submitted by Bell Atlantic Enterprises on January 10 into the FCC's LMDS public record.

Please place two copies of this submission into the above-referenced docket. Any questions regarding this submission should be directed to the undersigned.

Sincerely,

Brian D. Oliver

Enclosures

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List A B C D E

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January 12, 1994

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

Mr. Brian D. Oliver
President - Business Development
Bell Atlantic Enterprises Business Development, Inc.
1301 N. Courthouse Road
Arlington, VA 22201

Dear Brian:

Thank you for your letter of January 10, 1993 with a copy of the COMSAT study on "potential interference from LMDS into Ka-band satellites." Enclosed please find three tables with a line by line review of the Suite 12 and COMSAT calculations with a column denoting the difference.

COMSAT agrees with Suite 12 as follows:

- (1) LMDS does not interfere with NASA Conus, NASA Spot Beam and Motorola IRIDIUM. The margins vary between 30 and 40 dB and are dramatically greater than the CCIR and NASA recommendation of 10 dB.
- (2) We could not compare Project 21 since we do not have the actual input parameters. However, COMSAT again concludes a 30 to 50 dB margin, far in excess of the CCIR and NASA recommendation.
- (3) It is important to recognize that these calculations are for total LMDS interference levels relative to the noise level of the satellite receiver and appear 1/1000 to 1/10,000 below noise.
- (4) Since the desired signals of the satellite are generally 40 dB (10,000) above noises, then the total interference is 100 million times less than the desired signal.
- (5) Alternate (H&V) polarizations of adjacent LMDS cells is important and reduces the interference level by 3 dB (one-half) (Item 8).
- (6) Spectrum peaking (Item 7) is cancelled by the use of the LMDS frequency plan of interleaving diagonal cells (Item 11). Thus, another 3 dB improvement in the LMDS frequency plan.

Two problems are apparent in all of COMSAT's analyses which result in a 6 dB difference with Suite 12 and are probably the result of confusion. They are:

- (a) LMDS antenna side lobe gain (Item 12): Figure 2 (page 4) of the COMSAT report shows a -37 dB antenna isolation at an elevation angle of 10° and -34 dB for an angle of 30° with a worse case antenna isolation of better than -27.4 dB for all angles greater than 10° . COMSAT claims to have witnessed and verified the antenna measurements (page 2). Hence, the LMDS Hub antenna gain should be -15 dBi in all cases (-27.4 dB + 12.1 dB gain), not COMSAT's assumed -13 dBi. Thus, an error of 2 dB in all calculations.
- (b) (Diffuse scatter) (Items 21, 22, 23): Since diffuse scatter is a reciprocal event then, all satellites, independent of orbital position, would have severe interference via ground scatter into the satellite ground station, an event which does not occur. Moreover, COMSAT assumed a -14 dB scattering coefficient. The CCIR gives a range of values better than -14 dB up to -23 dB dependent on physical environment. Over 360° , LMDS antenna is expected to be worst case -18 dB for an error of 4 dB.

The result of (a) and (b) is a minimum 6 dB constant error in all of COMSAT's analysis.

In addition, the following major errors occur in separate cases:

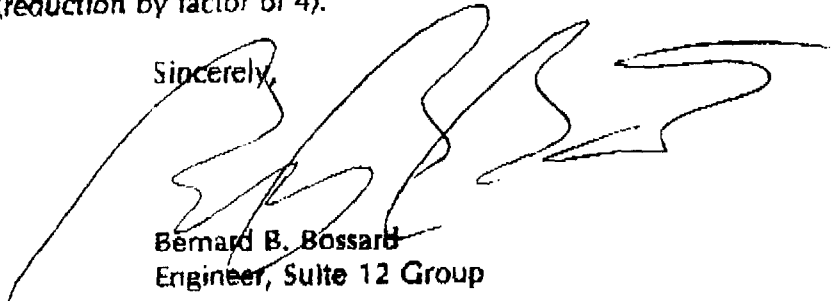
- (c) LMDS and IRIDIUM (Items 17 and 18): Items 17 and 18 result in a number of LMDS hubs of 84,900/52.2 or 1,626 which when multiplied by 0.26 (population factor) should be 422, or even 163 (population factor of 10%). Yet COMSAT uses 3,000 hubs \times 0.26 or 780. There cannot be any analysis which substantiates 3,000 LMDS hubs in the IRIDIUM beam. This error of 4.8 dB is simply a misplaced number. Thus, the total COMSAT error for IRIDIUM is approximately 11 dB (6 dB and 4.8 dB), about the difference of 9 dB between the COMSAT and Suite 12 calculations. COMSAT still agrees that LMDS cannot interfere with IRIDIUM.
- (d) LMDS and NASA Conus (Item 12): Item 12, satellite antenna gain. COMSAT assumed 32 dB while Suite 12 assumed 27 dB, for a difference of 5 dB. NASA uses 27 and 30 dB. Hence, a 2 to 5 dB error. The above errors (8 dB) account for the difference between Suite 12 and COMSAT. Still COMSAT calculates a C/I = -38 dB, much greater than the desired NASA C/I = -10 dB.
- (e) LMDS and NASA spot has the diffuse scatter error of 4 dB accounts for the difference. Again, COMSAT shows a C/I: -32 dB compared to a desired -10 dB.

Letter to Brian Oliver
January 12, 1994
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In conclusion, aside from a few misinterpretations, COMSAT and Suite 12 are in agreement that is impossible for LMDS when fully deployed throughout the United States, to interfere with any satellite, LEO, ICO or GEO.

Hence, use of the Suite 12 frequency plan always results in a 6 dB improvement of interference level at the satellite (reduction by factor of 4).

Sincerely,

A large, stylized handwritten signature in black ink, appearing to read 'BBB', is written over the typed name and title.

Bernard B. Bossard
Engineer, Suite 12 Group

Enclosures

For NASA ACTS SPOT Beam with 26% Population Factor:

Item Number (for reference)	Parameter Name	COMSAT	SUITE 12	Difference (Suite 12 - COMSAT)	UNITS
1	Cell Video HPA Size	100	100	0	WATTS
2	Tx HPA Size (dB)	20	20	0	dBW
3	Radiated Video Power	13	13	0	dBW
4	CCIR Limit	10	N/A	3	dBW
5	Total Video Bandwidth	1000	1000	0	MHz
6	Bandwidth (dB)	90	90	0	dB-Hz
7	Spectrum Peaking	3	0	-3	dB
8	Polarization Reuse	-3	-3	0	dB
9	Line Loss LMDS Tx	0	-1	-1	dB
10	Line Loss Sat Receiver	0	-1	-1	dB
11	Frequency Interleaving	-3	0	3	dB
12	Hub Antenna Sidelobe Gain	-13	-15	-2	dB
13	Path Loss to Satellite	-214	-213.3	0.7	dB
14	Atmospheric Loss	-1	-0.5	0.5	dB
15	Satellite Antenna Gain	53	53	0	dB
16	Rx WATTS/Hz per Video Hub	-258	-257.8	0.2	dBW
17	Average Cell Size	28.3	28.3	0	sq miles
18	Coverage Area sat beam	23,000	23,000	0	sq miles
19	Pop. Concentration Factor	5.85	5.0	0.85 (round to 0.9)	dB-%
20	# of Hubs per BEAM	211	257	46	hubs per beam
21	Rx WATTS/Hz backlobe	-234.8	-233.7	1.1	dBW/Hz
22	Rx WATTS/Hz diffuse scatter	-232.8	N/A	N/A	dBW/Hz
23	Rx WATTS/Hz TOTAL	-230.6	-233.7	-3.1	dBW/Hz
24	Satellite Nose Temp eq.	900	920	20	KELVIN
25	Thermal Density at SAT	-199.1	-199.0	0.1	dBW/Hz
26	Margin to CCIR Level	21.6 (rounding)	24.7	3.1	dB
27	Margin wrt Ambient	31.6 (rounding)	34.7	3.1	dB

For NASA ACTS CONUS Beam with 10% Population Factor:

Item Number (for reference)	Parameter Name	COMSAT	SUITE 12	Difference (Suite 12 - COMSAT)	UNITS
1	Cell Video HPA Size	100	100	0	WATTS
2	Tx HPA Size (dB)	20	20	0	dBW
3	Radiated Video Power	13	13	0	dBW
4	CCIR Limit	10	N/A	3	dBW
5	Total Video Bandwidth	1000	1000	0	MHz
6	Bandwidth (dB)	90	90	0	dB-Hz
7	Spectrum Peaking	3	0	-3	dB
8	Polarization Reuse	-3	-3	0	dB
9	Line Loss LMDS Tx	0	-1	-1	dB
10	Line Loss Sat Receiver	0	-1	-1	dB
11	Frequency Interleaving	-3	0	3	dB
12	Hub Antenna Sidelobe Gain	-13	-15	-2	dB
13	Path Loss to Satellite	-214	-213.12	0.88	dB
14	Atmospheric Loss	-1	-0.5	0.5	dB
15	Satellite Antenna Gain	32	27	-5.0	dB
16	Rx WATTS/Hz per Video Hub	-279	-283.62	-4.62	dBW
17	Average Cell Size	52.2	52.2	0	sq miles
18	Coverage Area sat beam	3,000,000	3,000,000	0	sq miles
19	Pop. Concentration Factor	10	10	0	dB-%
20	# of Hubs per BEAM	5747	5769	22	hubs per beam
21	Rx WATTS/Hz backlobe	-241.4	-246.01	-4.61	dBW/Hz
22	Rx WATTS/Hz diffuse scatter	-239.4	N/A	N/A	dBW/Hz
23	Rx WATTS/Hz TOTAL	-237.3	-246.01	-8.71	dBW/Hz
24	Satellite Nose Temp eg.	900	800	100	KELVIN
25	Thermal Density at SAT	-199.1	-199.57	-0.47	dBW/Hz
26	Margin to CCIR Level	28.2	36.44	8.24	dB
27	Margin wrt Ambient	38.2	46.44	8.24	dB

For MOTOROLA IRIDIUM 5-degree beam with 26% Population Factor:

Item Number (for reference)	Parameter Name	COMSAT	SUITE 12	Difference (Suite 12 - COMSAT)	UNITS
1	Cell Video HPA Size	100	100	0	WATTS
2	Tx HPA Size (dB)	20	20	0	dBW
3	Radiated Video Power	13	13	0	dBW
4	CCIR Limit	10	N/A	3	dBW
5	Total Video Bandwidth	1000	1000	0	MHz
6	Bandwidth (dB)	90	89.45	0.55	dB-Hz
7	Spectrum Peaking	3	0	-3	dB
8	Polarization Reuse	-3	-3	0	dB
9	Line Loss LMDS Tx	0	-1	-1	dB
10	Line Loss Sat Receiver	0	-1	-1	dB
11	Frequency Interleaving	-3	0	3	dB
12	Hub Antenna Sidelobe Gain	-13	-15	-2	dB
13	Path Loss to Satellite	-190	-189.1	0.9	dB
14	Atmospheric Loss	-1	-1.5	-0.5	dB
15	Satellite Antenna Gain	30.1	30.1	0	dB
16	Rx WATTS/Hz per Video Hub	-256.9	-256.95	-0.05	dBW
17	Average Cell Size	52.2	28.3	23.9	sq miles
18	Coverage Area sat beam	84,900	72,260	12,640	sq miles
19	Pop. Concentration Factor	Not used in calculation I	10 (Note: population factor of 10% used)	N/A	dB-%
20	# of Hubs per BEAM	780	256	524	hubs per beam
21	Rx WATTS/Hz backlobe	-228.0	-232.85	-4.85	dBW/Hz
22	Rx WATTS/Hz diffuse scatter	-226.0	N/A	N/A	dBW/Hz
23	Rx WATTS/Hz TOTAL	-223.9	-232.85	-8.95	dBW/Hz
24	Satellite Nose Temp eq.	1288	1295	7	KELVIN
25	Thermal Density at SAT	-197.5	-197.5	0	dBW/Hz
26	Margin to CCIR Level	16.4	25.35	8.95	dB
27	Margin wrt Ambient	26.4	35.35	8.95	dB

The performance of LP at intermediate points follows a simple law: the relative energy coupled is equal to the square of the cosine of the angle. This characteristic is plotted at the left of Figure 3-7 for the co-polarized case, i.e., for the level of signal received as the receiving antenna is rotated from maximum coupling to minimum coupling. An ideal LP wave and antenna are assumed, for which the coupling goes from a maximum of one to a minimum of zero. Maximum coupling will always occur at some angle and minimum coupling will be as close to zero as physically possible. Properly designed and installed antennas can deliver minimum coupling values of 0.0001, or -40 dB.

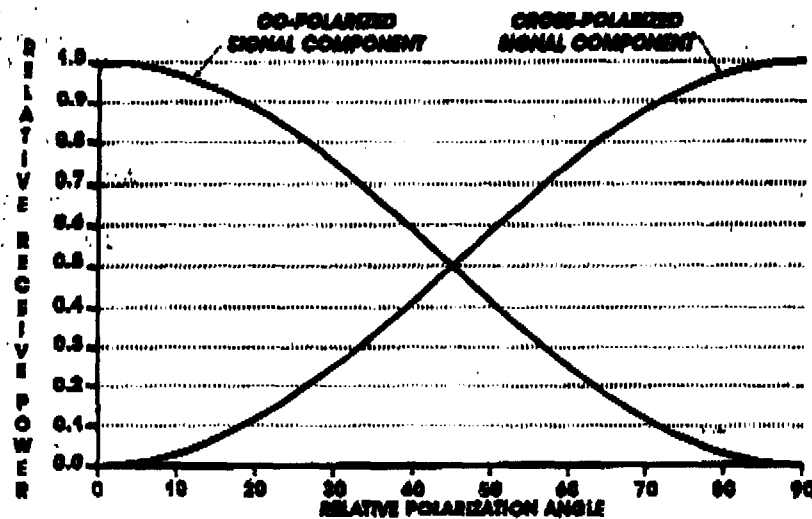


Fig. 3-7 Relative Receive Power as a True Ratio for the Co-Polarized and Cross-Polarized Signals in a Linearly Polarized Link as the Polarization Angle of the Receiving Antenna is Rotated

Probably the most important application of polarization is in *frequency reuse*, where two cross-polarized signals are transmitted at the same time on the same frequency. The right-hand curve in Figure 3-7 shows how the level of the cross-polarized signal increases as the receiving antenna is rotated from zero to 90 degrees. Notice how at 45 degrees, both signals are at the same level. Figure 3-8 plots coupling in dB, termed *polarization isolation*, between the desired and undesired polarizations. Maximum isolation occurs at zero offset angle, i.e., where the receiving antenna is aligned in polarization with the transmitting antenna and the undesired polarization is "nulled" out (minimized). Alignment